

# Air Traffic Control Tower Augmented Reality Field Study

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## 1. Introduction

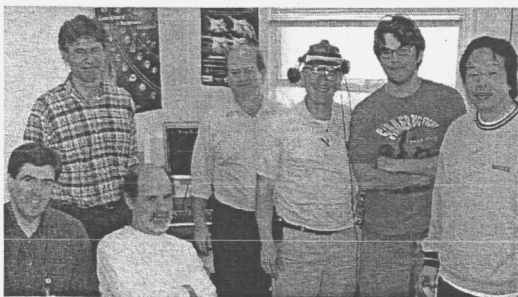
The National Aeronautics and Space Administration (NASA) is currently developing an Augmented Reality Tower Tool (ARTT), a head-tracking see-through, head-mounted display (HMD) system for use by air traffic tower controllers, particularly during low-visibility conditions. The prototype ARTT uses a novel 'see-through' technology to enhance the controller's normal view with superimposed computer text and graphics. In 2004 ARTT began using a real-time Federal Aviation Administration (FAA) Northern California Terminal Radar Approach Control (TRACON) (NCT) secure data feed to track aircraft in the Moffett Field vicinity. In 2005 Moffett Field Aviation Management authorized ARTT development and evaluation at Moffett Tower. This is the first time an AR system using live radar data has been studied at an operational Air Traffic Control (ATC) Tower.

## 2. ARTT Field Study Milestone

The concept of using AR displays for ATC Tower decision-support tools has been discussed repeatedly over the last decade, though always in the context of laboratory or simulation studies [Reisman and Ellis 2003; Schmidt-Ott, et al. 2002]. The Moffett Tower installation marks the first time this technology has been evaluated using real-time ATC data in an operational facility, and evaluated by a cadre of controllers using the augmented reality (AR) systems to observe live air traffic.

## 3. Installation at Moffett ATC Tower

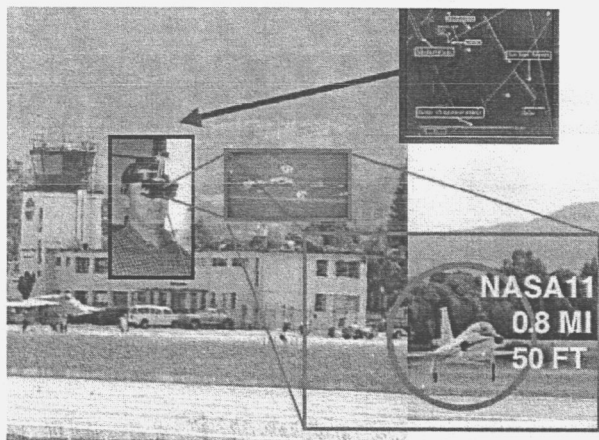
The multi-disciplinary team (e.g. aerospace human-factors, air traffic control automation, experimental psychology, system & network administration, and, of course, 3-D graphics software development) installed ARTT on March 9, 2005.



ARTT Field Study Development Team (L to R):  
David Brown, David Encisco, Bernard 'Dov' Adelstein, Ron Reisman, Stephen Ellis, Michael Hill, Mathias Ma.

Not Pictured: Phil Zinno, Brian Ujvary, Aaron Maul, James Murphy, Jinn-Hwei Cheng, Akbar Sultan, and Ahmad Khalil. Controller Cadre: Will Golden, John Moor, Bill Smith, James Grippi, Sam Andrade, and Robert Remick.

Thanks for support: Richard Mogford, Mal Cohen, Michelle Eshow, Wardell Lovett, T.J. Forsyth, and Rich Jehlen.



ATC live radar is sent to prototype ARTT system in the Moffett Tower. The see-through head-mounted display superimposes CGI and text onto aircraft optical images.

## 4. Evaluation Protocols

ARTT is currently at an early developmental stage, and will not be certified for operational use for many years. The ARTT safety plan requires that the on-duty controller is unencumbered, while a second controller (who does not control traffic while evaluating ARTT) uses ARTT in a purely evaluation mode.

## 5. Plans for Future ARTT Development

ARTT will concentrate on tracking surface movement in FY06, with greater emphasis on integrating GPS and alternative radar data sources. There is particular interest in using ARTT technology verify the ATC digital model of vehicle position and behavior. The development, calibration and validation of the ARTT system will also aid in the development of a fully virtual tower systems that need not be co-located at the airports they serve.

ARTT is becoming more mobile and 'wearable', enabled by commercially available head-tracking sensors that do not require external reference hardware, and full-featured small commercial computers (e.g. the OQO device used in the current mobile ARTT configuration). ARTT will also require improved 'see-through' HMD technology that does not impair the users' view of the real world.

## 6. References

- REISMAN, R. and ELLIS, S. 2003. *Augmented Reality for Air Traffic Control Towers*. Sketch 303, Siggraph 2003.
- SCHMIDT-OTT, J., ELLIS, S., ADELSTEIN, B., REISMAN, R., GIPS, J., AND KROZEL, J. 2002. *Augmented Reality in a Simulated Tower Environment: Effect of Field of View on Aircraft Detection*. NASA TM-2002-211853.